

WHAT IS CLAIMED IS:

1. A bore hole opener for enlarging a bore hole underneath a casing, comprising:

5 an elongate, generally cylindrical body;

a duct for drilling fluid, being formed longitudinally in the body, and having a fluid passage cross-section of inside radius i ;

10 at least two hole-opening arms being movably coupled with the body, each hole-opening arm being extendible from a first position in which the hole-opening arm is generally flush, or retracted with respect to the body, and a second position in which a cutting mechanism of the hole-opening arm is at least partially extended with
15 respect to the body;

each hole opening arm having a respective intermediate support that is coupled with the body and operable to provide support to the hole-opening arm along a distance g , when the hole-opening arm is in the second
20 position;

wherein each hole-opening arm extends from the body a distance o , when the hole-opening arm is in the second position; and

25 wherein the values of i , g and o are chosen to simultaneously satisfy the following conditions:

$$i + g + o = s;$$

$$0.30 < i/s < 0.45, \quad 0.40 < g/s < 0.60, \quad 0.07 < o/s < 0.20.$$

2. The bore hole opener of Claim 1, wherein the values of i , g and o are chosen to further satisfy the following conditions:

5
$$0.34 < i/s < 0.39, \quad 0.45 < g/s < 0.53, \quad 0.10 < o/s < 0.16.$$

3. The bore hole opener of Claim 1, wherein each hole-opening arm includes a cylindrical portion of diameter d , and d is greater than or equal to g .

10 4. The bore hole opener of Claim 2, wherein each hole-opening arm includes a cylindrical portion of diameter d , and d is greater than or equal to g .

15 5. The bore hole opener of Claim 1, wherein each hole-opening arm includes a face that is internal to the body, the face being designed and positioned to be subjected to pressure of the drilling fluid flowing through the body, such that an increase in the pressure
20 of the drilling fluid may be used to force each hole-opening arm from the first position to the second position.

25 6. The bore hole opener of Claim 1, wherein each hole-opening arm is coupled with respect to the body, such that each hole opening arm slides along a respective axis from the first position to the second position, and the axis is parallel to a central axis of the hole-opening arm.

7. The bore hole opener of Claim 1, wherein, to
move the hole-opening arms from the second position to
the first position, the bore hole opener comprises means
5 for elastically returning the hole-opening arms.

8. The bore hole opener of Claim 1, wherein each
hole-opening arm is kept in the first position prior to a
hole-opening operation, by at least one pin designed to
10 break when the pressure of the drilling fluid flowing
through the duct exceeds a predetermined value higher
than a maximum usual boring value.

9. The bore hole opener of Claim 1, wherein each
15 hole-opening arm is mounted in the body using the
intermediate support, the intermediate support providing
a housing for the hole-opening arm in the body and the
intermediate support being fixed to the body.

20 10. The bore hole opener of Claim 8, wherein the
each pin fixes the respective hole-opening arm to the
intermediate support.

11. The bore hole opener of Claim 10, wherein, to
25 move the hole-opening arms from the second position to
the first position, the bore hole opener comprises means
for elastically returning the hole-opening arms, and
wherein the intermediate supports, the hole opening arms,
the elastic return means and the pins constitute
30 assemblies designed to be assembled in advance outside
the body and then installed within the body.

12. The bore hole opener of Claim 8, wherein the pin comprises a region of calibrated weakness, at a point of transition where the pin passes from the body into the arm hole opening arm.

5

13. The bore hole opener of Claim 8, wherein the pin comprises a region of calibrated weakness, at a point of transition where the pin passes from the intermediate support into the arm hole opening arm.

10

14. The bore hole opener of Claim 1, further comprising:

a longitudinal passage extending longitudinally along a surface of the body between the two hole-opening arms, to allow return of the drilling fluid; and

15

a boss disposed within the longitudinal passage to deflect the drilling fluid onto a portion of the wall of the bore hole upon which the hole-opening arms are acting.

20

15. The bore hole opener of Claim 1, further comprising a plurality of stops being coupled with the body and being operable to limit movement of the hole-opening arms from the first position to the second position such that, in the second position, the hole-opening arms sweep through an area having a largest diameter that is equal to between 1.05 and 1.3 times the nominal diameter of a drill bit associated with the bore hole opener for a combined drilling and hole -opening operation.

25

30

16. The bore hole opener of Claim 15, wherein the largest diameter is approximately equal to 1.15 times the nominal diameter of the drill bit.

5

17. The bore hole opener of Claim 8, wherein each pin is operable to limit movement of the respective hole-opening arm, such that the hole-opening arms are retracted with respect to the body when the hole-opening arms are in the first position.

18. A bore hole opener for enlarging a bore hole underneath a casing, comprising:

an elongate, generally cylindrical body;

5 a duct for drilling fluid, being formed longitudinally in the body, and having a fluid passage cross-section of inside radius i ;

at least two hole-opening arms being movably coupled with the body, each hole-opening arm being extendible from a first position in which the hole-opening arm is generally flush, or retracted with respect to the body,
10 and a second position in which a cutting mechanism of the hole-opening arm is at least partially extended with respect to the body;

the body having at least two intermediate supports each being operable to guide a respective one of the hole-opening arms from the first position to the second position, and provide support to the hole-opening arm along a distance g , when the hole-opening arm is in the second position;

20 wherein each hole-opening arm extends from the body a distance o , when the hole-opening arm is in the second position; and

wherein the values of i , g and o are chosen to simultaneously satisfy the following conditions:

25

$$i + g + o = s;$$

$$0.30 < i/s < 0.45, \quad 0.40 < g/s < 0.60, \quad 0.07 < o/s < 0.20.$$

19. The bore hole opener of Claim 18, wherein the values of i, g and o are chosen to further satisfy the following conditions:

$$0.34 < i/s < 0.39, \quad 0.45 < g/s < 0.53, \quad 0.10 < o/s < 0.16.$$

5

20. The bore hole opener of Claim 19, wherein each hole-opening arm includes a cylindrical portion of diameter d, and d is greater than or equal to g.

10